

# CAREER: New Materials in Condensed Matter Physics: The Case of Quasicrystals

Ian Fisher, Stanford University, DMR-0134613

- Our lab concentrates on the development of new materials, focusing on those with exotic magnetic and electronic properties.
- One area of current interest is quasicrystals. These materials exhibit long-range atomic order but without the translational symmetry of conventional crystals. Key questions include: how does this kind of atomic order affect the magnetic and electronic properties of a solid, and what is the influence of the degree of structural perfection?
- To experimentally address the above questions requires the growth of single quasicrystal samples. Fig. 1 shows a new phase that we have recently been able to synthesize in single grain form.
- Details of the physical structure of the material shown in Fig. 1 (it has a primitive icosahedral symmetry, in contrast with most other icosahedral quasicrystals) make R-Mg-Cd a particularly attractive material to study.
- Results for this material and others like it (for instance the conductivity of Al-Pd-Re, shown in Fig.2) help us to understand the key differences between periodic and non-periodic ordered solids.

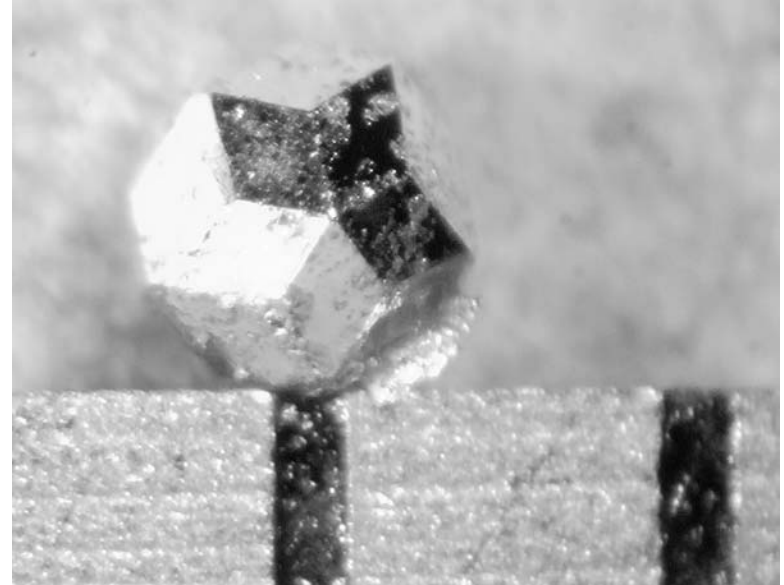


Fig. 1. Photograph of a single quasicrystal of Tb-Mg-Cd over a mm scale. The sample has an unusual rhombic-triacontahedral morphology: note the axis of 5-fold rotational symmetry which is forbidden in periodic crystal structures. These are the first single-grain samples of this material, which allows a detailed investigation of their thermodynamic and transport properties.

# CAREER: New Materials in Condensed Matter Physics: The Case of Quasicrystals

Ian Fisher, Stanford University, DMR-0134613

## Brief summary of outreach activities:

- Extensive undergraduate involvement in laboratory research.
- Continued involvement in undergraduate dorm events, elevating awareness of the role that materials research plays in both fundamental physics and technological applications through talks and discussions.
- In addition, the PI teaches a lecture course for non-science majors based on the physics of everyday objects and phenomena – this course plays an important role in communicating science to a broad audience.

## Educational:

- 2 undergraduates funded by this award
- 1 grad student funded by this award

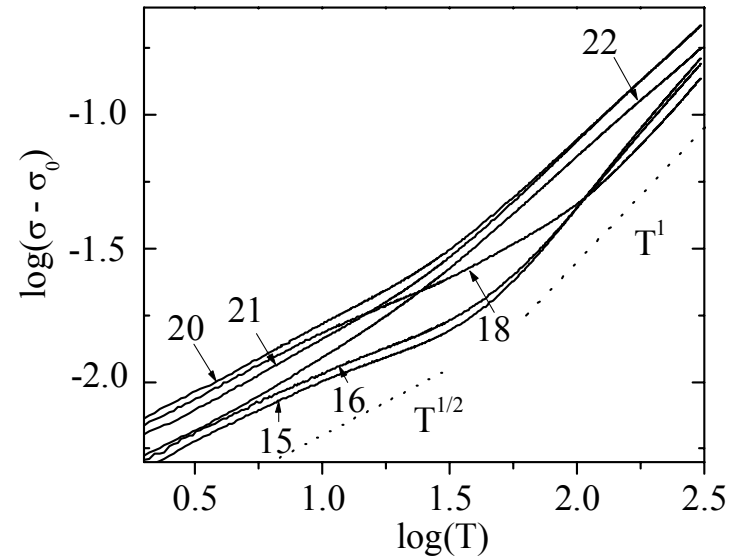


Fig. 2. Conductivity data for single grain Al-Pd-Re quasicrystals; labels indicate Pd content. Data like these help to determine how electrons are moving around in the quasicrystal environment. In this case, the conductivity is dominated by weak localization, although there is considerable discussion as to whether more localized behavior can develop under certain circumstances. Single-grain samples allow us to experimentally address such questions.